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## Article

# An Analysis of the Tax Incidence of VAT to Milk in Malawi

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**Abstract:** Dairy is a key investment sector for the Government of Malawi. On 1 October 2016, the Malawi Revenue Authority announced that milk, which until then had been exempted from value added tax (VAT), was going to be taxed at the standard rate of 16.5 percent. The measure has been met with strong opposition and thus, was short lived (eliminated in May 2017). The purpose of this paper is to present an analysis of the effect that such a tax would have on its incidence, on the different stages of the supply chain, and ultimately on its economic and social sustainability. The paper investigates these implications by developing a multimarket model applied to the Malawian dairy supply chain. The results indicate that 24.3 percent of the VAT revenues would be borne by consumers and the remaining 75.7 percent would be borne by the domestic dairy industry (i.e., processors and smallholder farmers). This was due mainly to the value of the price elasticity of consumers' demand for pasteurised milk. The results highlight the vulnerability of inclusive value chains to economic policies that may affect consumers' demand.

**Keywords:** Malawi; dairy industry; VAT; tax incidence analysis; supply chain models

## 1. Introduction

As pointed out by [1], smallholder value chains are exposed to a number of shocks. On the supply side, production may be affected by climatic events that leaves smallholders with little to sell or having to choose between selling their produce or using it for their own consumption. On the demand side, an increase in the price faced by final consumers reduces the demand for the upstream product. Additional shocks may come from sudden changes in government policy and may affect both supply and demand. Ref. [2] tells the story of sorghum beer in Kenya, which illustrates the effect that government policy may have on the development of smallholder value chains. In 2013, the Government of Kenya increased the tax revenue by imposing an excise duty of 50 percent on sorghum beer, which resulted in economic losses for smallholders, the brewery industry, and for the government itself, as it effectively obliterated the value chain. In 2015, the government reversed the policy decision and reduced the excise duty to 10 percent.

A similar story can be told for the case of Malawi, although regarding the value added tax, which is a consumption tax placed on a product whenever value is added at each stage of the supply chain, from production to the point of sale. The amount of VAT that the user pays is on the cost of the product, less any of the costs of materials used in the product that have already been taxed [3]. VAT introduction was short lived. Dairy (farming and processing) is a key investment sector for the Government of Malawi [4], and donors have also been committed to the development of the supply chain [5–7]. Several value chain studies have discussed strategies to improve the dairy sector performance and raise its contribution to poverty alleviation and food security [5–9].

On 1 October 2016, the Malawi Revenue Authority announced that domestic pasteurised milk, which had been exempted from VAT previously, was going to be taxed at the standard rate of 16.5 percent (the measure excluded infant milk). This was the third time that the Government of Malawi imposed VAT to milk, after two earlier similarly fleeting attempts.

The tax was announced in July 2016 and published in October 2016 but was not implemented until November of the same year due to complaints against it. Note that the introduction of the VAT was not only on milk but on almost all products previously not taxed, and thus the probability that the Government of Malawi was going to make an exception for milk was low. The VAT added 90 Kwachas to the price per litre of milk sold at the retail level. The introduction of VAT on domestically produced pasteurised milk increased the retail price and further decreased the demand during a period of low seasonal demand. In addition, processors cut the farmers' price by 9 percent to reduce the increase in the price of the product at the retail level. The measure was met with strong opposition and thus, was short lived i.e., eliminated in May 2017.

The purpose of this paper is to analyse the incidence of such a tax along the domestic dairy supply chain. This provides unique information about the functioning of the Malawian dairy supply chain, in particular its sensitivity to government policy and any related changes in the demand. The purpose of this paper is to use the brief VAT episode to extract potential lessons for the domestic dairy industry.

This paper responds to the [10] question on whether taxes levied on goods are completely shifted to consumer prices, or if the incidence also falls on firms. The question is important for both policy and scientific research, as consumption taxes make up a large part of the fiscal revenue in most developed and developing countries and may impact fairness and consumers' welfare (e.g., [11]). The typical assumption is that consumer prices fully reflect taxes; however, according to [12], the evidence supporting this is limited.

In our view, the topic is important because it shows how taxation in developing countries can affect an inclusive supply chain such as the dairy one, the welfare of poor farmers, and government's plans to foster growth in the agri-food sector. In this sense, by introducing the VAT, the government led to a contraction in the demand for domestic milk, which had implications both upstream the supply chain and for the consumers. An inclusive business model is a commercially viable model that benefits low-income communities by including them in a company's value chain on the demand side as clients and consumers, and/or on the supply side as producers, entrepreneurs, or employees in a sustainable way [13,14]. This highlights the vulnerability of supply chains in developing countries to economic policy and the extent to which this may affect their economic and social sustainability.

Following a brief literature review focused mostly on the implementation of VAT in developing countries and particularly in Africa, the paper describes the situation of the Malawian dairy sector pre- and post-introduction of the tax and presents the multimarket model used to simulate the impact of the rise in the VAT, data used, and model calibration details. The implications of the findings are discussed in the context of the ongoing debate around taxation policies for agri-food value chains in developing countries.

## 2. Literature Review

This section provides a brief overview of the taxation literature related to the introduction and implementation of VAT in developing countries, Africa in particular, and those issues that pertain to this paper, i.e., effects of taxation of the final product of an agri-food supply chain such as the tax incidence.

According to [15], since its introduction in France in the 1950s, VAT has been adopted in more than 160 countries, including a majority of low- and middle-income countries (LMICs). Its purpose is to tax final consumption but leave intermediate transactions between VAT-registered firms untaxed in order to avoid distorting production and supply-chain decisions.

VAT is an important source of revenue for countries. According to the Organisation for Economic Co-operation and Development Centre for Tax Policy and Administration and the African Union

Commission [16], tax revenues increased by 1.5 percent of the gross domestic product (GDP) on average between 2008 and 2017 as a result of increases in revenues from VAT (0.7 percentage points) and from taxes on income and profits (0.3 percentage points) driven entirely by a 0.7 percentage points increase in revenues from personal income taxes. The increase in the African (based on 26 countries) average tax-to-GDP ratio was higher than the increase for Latin America and the OECD averages (both 1.3 percentage points). The African average has plateaued at 17.2 percent since 2015, with increases in tax-to-GDP ratios in some countries being offset by decreases in others. The greatest source of tax revenues among the countries featured in this publication were taxes on goods and services, which accounted for 53.7 percent of the total tax revenues on average in 2017, with VAT alone contributing 29.4 percent.

Ref. [17] provides a recent overview of the VAT situation in Africa (see also [18,19]). According to him, two kinds of VAT were introduced on the African continent. The Southern African Customs Union (SACU) countries (i.e., Botswana, Eswatini, Lesotho, Namibia, and South Africa) modelled their VAT, at the initiative of South Africa, on the New Zealand good and service tax (GST), which has few exemptions and is essentially levied at a single rate (by contrast, SACU countries zero-rate a limited number of unprocessed foodstuffs and kerosene). The design of the threshold level of turnover above which businesses are required to register and charge VAT on their output and entitled to reclaim tax on their inputs invoiced by other registered businesses, is one of the most important issues under VAT [20]. Too high a threshold may be costly in terms of revenue and unduly distort business organization around the threshold. Too low a threshold may involve high administration costs for the VAT department and disproportionately high compliance costs for small taxpayers. As a result, the VATs in Southern Africa are exceptionally revenue productive. Kenya also moved closer to the New Zealand model.

The VATs in all other African countries are based on the EU VAT taxation, be it the UK, France, or Portugal version, although with some variability. These VAT versions have more exemptions and differentiated rates than the New Zealand GST and, therefore are more complicated. Southern African Development Community (SADC, Gaborone, Botswana) member countries (outside SACU and with the exception of DR Congo, Madagascar, and Mozambique), the East African Community (EAC) countries (except Burundi and Rwanda), the West African Monetary Zone (WAMZ) countries (except Cabo Verde and Guinea), and the members of the Intergovernmental Authority on Development (IGAD) based their VATs mainly on the UK legislation (Malawi is one of these cases). Like the UK, most of these countries apply a zero rate to various essential products, which is not permitted under the Common Directive. Most other countries follow the French version of VAT but, according to [17], this has a civil law flavour different from the UK VAT. Cabo Verde, Guinea-Bissau, and Mozambique have a Portuguese type of VAT.

According to [17], the standard VAT rate ranges from 10 percent in Djibouti to 20 percent in Madagascar, Morocco, and Tunisia. The standard rate of most VATs is 15 percent or higher. The lower rates are found predominantly in Southern Africa, where VATs are particularly broad-based. The zero rate, mainly applied to some unprocessed foodstuffs, is generally confined to countries with Anglo-Saxon taxing traditions. Countries with French taxing traditions do not have a zero rate on domestically produced or consumed goods.

The introduction of the VAT in Malawi was triggered by a deterioration in the country's economic situation. In the early 1980s, the flow of external funds to Malawi decreased significantly, which coincided with the loss of its primary foreign trade route (between 80 to 90 percent of exports and imports) due to the closure of rail lines in Mozambique. These shocks resulted in a sharp increase in the servicing of Malawi's external debt and defence spending, thereby creating a pressing need for more revenue. At first, the Government raised the rates on those tax bases that were, administratively, the easiest to tax, such as trade. By 1985, the tax to GDP ratio had increased by almost 50 percent. However, it was increasingly apparent that the ad hoc, temporary measures were inconsistent with the creation of a more liberal economic environment in the long run, which led to a reform of the tax system [21]. A comprehensive tax reform was carried out in the second half of the 1980s with

assistance from the World Bank, with the VAT being formally introduced in Malawi in 1989 [22] under the name of “surtax.” The registration threshold (minimum annual turnover) is 10 million Malawi Kwachas (approximately US \$13,500) and the standard rate is 16.5 percent. The supply of some goods and services is exempt from VAT. However, all imports are generally subject to VAT except for goods used in agricultural trade or exempt from duty.

In economics, tax incidence or tax burden is the effect of a particular tax on the distribution of economic welfare. The tax burden represents the true economic weight of the tax, measured by the difference between real incomes or utilities before and after imposing the tax. As pointed out by [23], the equity and distributional effects of VAT and its potentially distorting economic effects are always a matter of concern (see also [24–28]). Reality, however, indicates that most countries, particularly developing countries, cannot finance the education, health, and infrastructure development they need to sustain growth without recourse to some form of general consumption tax. This is similar to the views expressed by [29] who argue from a policy viewpoint that net fiscal incidence is the relevant equity measure that government authorities need to use in judging particular policies. For example, an increase in VAT may be rejected on equity grounds as being regressive but may be desirable from an equity standpoint if the resulting revenues are used to finance, for instance, primary-school services in poor neighbourhoods. Taxes can be progressive but, if the transfers to the poor are not sufficiently large, they may exacerbate poverty.

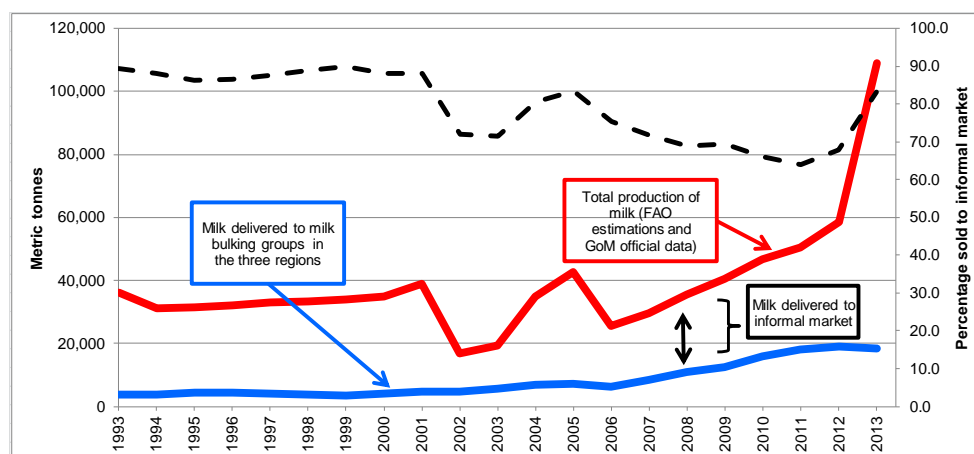
As it is well known in public finance [30], key for the incidence of a tax such as the VAT are both the price elasticity of demand and price elasticity of supply. General rule claims that the steeper the demand curve and the flatter the supply curve, the more of the tax will be borne by consumers; and the flatter the demand curve and the steeper the supply curve, the more of the tax will be borne by producers [30]. Ref. [10] analysed the effects of a decrease in the VAT on food in Norway. Her findings suggest that taxes levied on food are completely shifted to consumer prices, with only a few spill-over effects to most other goods. Moreover, she found that lowering the VAT on food attenuates inequality in consumer welfare, in part because households adjust their spending patterns in response to the price change. It should be noted that [31], indicated that in contrast to the standard incidence model—where the direction of a tax change does not matter for incidence, as supply and demand elasticities are sufficient to determine the proportion of the tax borne by each agent—it is possible for the response to prices to be asymmetric to variation in VATs showing that there is a consistently higher pass-through to prices for tax increases than for tax decreases. Ref. [32], using monthly observations on consumer prices and VAT rates for around 70 commodity groups in 17 Eurozone countries over 1999–2013 studied the extent of pass through. They found the impact on consumer prices to vary systematically and sharply across the different types of VAT reform, with full pass confirmed for changes in the standard rate, but pass-through for reduced rates to be lower. Ref. [33] analysed the incidence of VAT in Mexico following two tax reforms that increased the VAT rate for a group of cities and left the rest unaffected. They compared the inflation rate in the affected cities with that in the exempted cities before and after the law changed, found that the effect on prices was limited and concluded that the burden of the tax was shared between producers and consumers. Ref. [34] studied the introduction of a 3 percent VAT for retailers against the existing normal rate of 17.5 percent in Ghana and concluded that the incidence of VAT is on the consumers. Ref. [35] studied the introduction of VAT in South Africa using a computable general equilibrium (CGE) model and found that it negatively impacted the welfare of low-income households. Ref. [36], used a CGE model to study the increase by 1 percent of the VAT in South Africa, and found that it affected not only the cost of living (i.e., consumers) but also the short-run cost to the employer.

The literature has focused on significant tax reforms in developed or developing countries applying to large groups of goods (e.g., food) or all goods and services, in contrast to changes in the VAT rate for a final good, which is the focus of this paper. This allows concentrating the analysis in the context of a particular market and highlighting some of the particularities of the supply chains (e.g., [37]), such as the presence of an informal market. In this sense, the present paper aims to contribute to

the VAT literature not only by measuring the incidence of the tax but the effects that it brings to the supply chain.

### 3. The Dairy Sector in Malawi and the VAT

Figure 1 is useful not only for presenting the major characteristics of the dairy sector in Malawi but also for providing an overview of its evolution [7]. The dairy market is characterised by the coexistence of formal and informal trading of milk. The formal sector markets pasteurised milk (amongst other products), whilst the informal sector trades raw milk. Figure 1 provides an indication of the size of both markets, which, as shown by the evolution, is not constant.



**Figure 1.** Milk production, deliveries to processors and the informal market. Source: Own elaboration based on data provided by the Malawi Milk Producers Association, the Shire Highlands Milk Producers Association (SHMPA) and the Government of Malawi, Agriculture Production Estimates Survey.

The red line in Figure 1 represents the total milk produced in Malawi according to the Agriculture Production Estimates Survey (this includes milk from the dairy and beef herds). The blue line in Figure 1 indicates the collection of milk by milk bulking groups (MBGs), i.e., the milk that is pasteurised, packaged, and sold by retailers. The level difference between the red and blue lines represents milk that remains outside the formal market and is either consumed on farms, wasted, or sold by informal vendors.

The dotted line in Figure 1 (measured on the right axis) represents the proportion of the total milk production outside the formal sector. Figure 1 indicates that a sizable part of the milk supply is consumed unpasteurised and without any quality control (between 70–80 percent at the end of period recorded in Figure 1).

In terms of international trade, Malawi imported US \$735,522 worth of products under the United Nations (UN, New York, NY, USA) Comtrade's 04.01 "Milk and cream, not concentrated nor containing added sugar or other sweetening matter" (714,731 kg) in 2015, of which 89.9 percent were exempted from tariffs due to the fact that they originated from countries members of the Common Market for Eastern and Southern Africa (COMESA) or SADC (Gaborone, Botswana). Among these, the most important trading partner is South Africa, which represents the source of 78.9 percent of the Malawian imports.

There is limited published information on the food consumption in Malawi, and dairy is not an exception. Available data are either estimates based on the apparent consumption (i.e., production plus imports plus net decrease in stocks minus exports) or sourced from the Living Standards Measurement Surveys [38]. Malawi has the lowest consumption of milk per capita among African countries, which was estimated at 4.7 kg/capita/year compared to an African average of 15 kg/capita/year [6,38]. The demand for dairy products in Malawi includes mostly fresh milk, followed by powdered milk

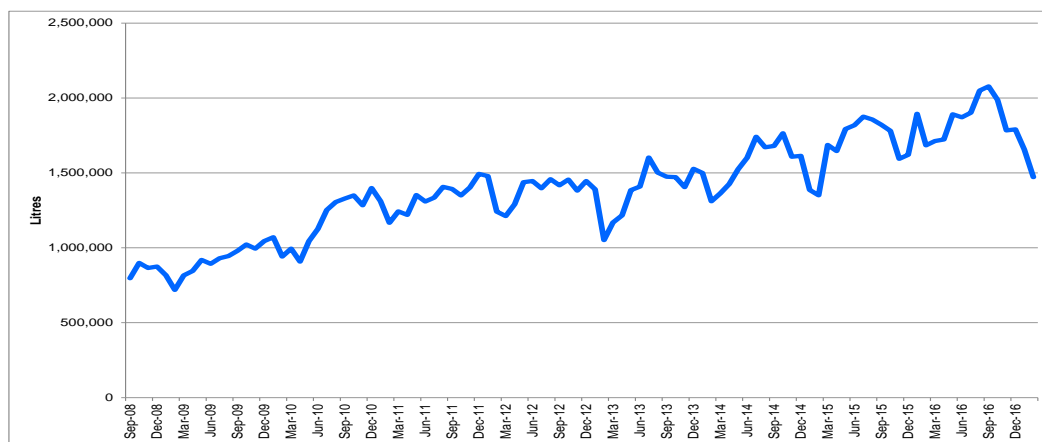


(which is imported for the more affluent population), margarine, butter, chambiko (a type of liquid yoghurt), yoghurt, and cheese.

The introduction in 2016 of a standard VAT rate of 16.5 percent for domestic pasteurised milk (excluding infant milk) previously exempted not only the milk produced domestically but also remaining imports of milk under the customs code 04.01 (UN Comtrade database). The heading 4.1 includes the subheadings 4.1.1 (fat content not exceeding 1 percent), 4.1.2 (fat content exceeding 1 percent but not exceeding 6 percent), 4.1.4 (fat content exceeding 6 percent but not exceeding 10 percent) and 4.1.5 (fat content exceeding 10 percent). All subheadings are taxed with a custom tariff of 30 percent (e.g., from the European Union) with some exemptions. Namely, for imports from COMESA, the rate is 3 percent, while imports from SADC, either from South Africa or other countries, are tax free. In addition, there is a withholding tax of 3 percent.

Hence, with the implementation of VAT in November 2016 for both imported and domestic products, milk products sold at the retail level were all subject to the VAT rate of 16.5 percent, which implicitly led to an increase in the retail price and a further decrease in demand during what is typically the lowest sales period in the year (January). Moreover, in February 2017, processors reduced milk price by 9 percent, i.e., from 170 Kwachas (US\$ 0.23) to 155 Kwachas (US\$ 0.21) in order to reduce the increase in the retail price. After discussions between the government, milk processors and other stakeholders, the tax was eliminated in May 2017.

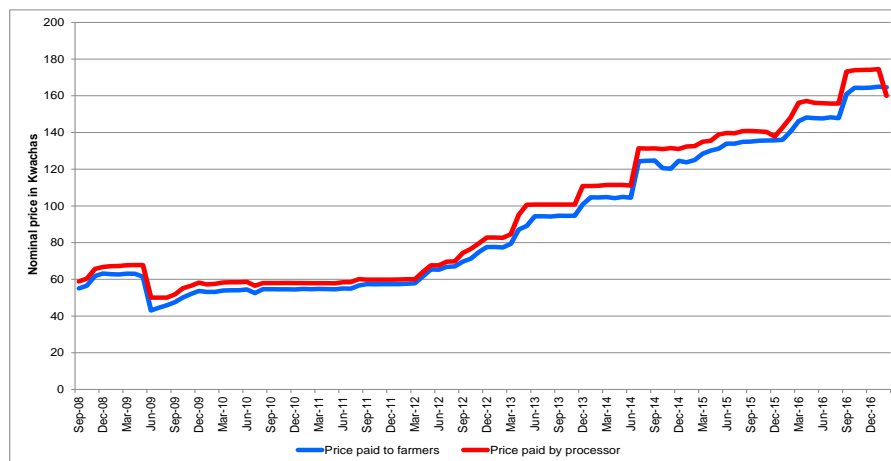
Figure 2 shows the milk collection of the MBGs belonging to Shire Highlands Milk Producers Association (SHMPA). Despite the seasonality in the milk collection, the contraction in the collection of milk following implementation of VAT is clear. When comparing the months January and February 2017 against the same period the previous year, the decrease in milk collection was 7.3 percent.



**Figure 2.** SHMPA Milk collection. Source: Based on SHMPA data.

Figure 3 shows the evolution in nominal terms of the prices paid by processors and the prices received by farmers. Note that processors pay for their milk collection to the MBGs and the MBGs pay the farmers. The difference between prices represents the administrative costs of the MBGs. The figure shows the decrease in the price paid by processors in February 2017, which was not yet passed to farmers by most MBGs. This situation, however, is only sustainable in the short term and only as far as the MBGs have the capacity to incur temporary losses.

The following section presents the data and model used to analyse the effects of the introduction of the VAT to dairy products.



**Figure 3.** Nominal prices paid by processors and prices paid to farmers by milk bulking groups (MBGs). Source: Based on SHMPA data.

#### 4. Materials and Methods

This section introduces the model used for the empirical analysis and explains how the parameters of the model were calibrated prior to estimation. The reason for using and not econometrics relates to the relatively limited information available for the Malawian dairy supply chain and the need to ensure that the model reproduces accurately the baseline situation i.e., pre-tax (see [39,40] as regards the use of calibration for supply and demand models, respectively).

##### 4.1. Dairy Supply Chain Model

We used a partial equilibrium model, which is a simplified version of the model presented in [41], on the regional structure of the Malawian dairy supply chains. In contrast to computable general equilibrium models, partial equilibrium models include greater detail of the markets, institutions, and policies and thus allow for more detailed predictions of the impact of specific policies [42]. Multi-market models have proven particularly popular for agriculture sector analysis [43]. The focus on the change in VAT for one product in contrast to taxation of several or all goods in the economy further justifies the methodological choice.

The starting point of the model is the production of milk, which comes from the native zebu or from other breeds (these include exotic breeds or mixed breeds). The supply of milk ( $Y$ ) is given by Equation (1):

$$Y = y \cdot C \quad (1)$$

where  $y$  is the milk yield and  $C$  is the number of cows in the production cycle. The milk yield (milk produced per cow) is assumed to be exogenous and equal to the observed average. The farmers' production decision consists of choosing the number of cows to milk, which determines the total milk produced. Equation (2) presents the milk being delivered to milk bulking groups ( $B$ ), where  $\varphi$  is the proportion of the milk delivered to the MBGs:

$$B = \varphi \cdot Y = \varphi(P^F, P^I) \cdot Y \quad (2)$$

The quantity of milk pasteurised by the processors ( $YP$ ) is given by Equation (3):

$$YP = \alpha \cdot B \quad (3)$$

where  $\alpha$  is the proportion of the milk collected by MBGs for pasteurisation at processor  $j$ . Note that  $\alpha$  is lower than 1 because some of the milk is wasted or further processed into e.g., chambiko, liquid yoghurt, yoghurt, ice cream.



Finally, the total consumption/purchases of domestic pasteurised milk are given by Equation (4):

$$CP = C - CM - CI = YP \quad (4)$$

where C is the total consumption of milk, CM is the total consumption of powder milk, and CI is the total consumption of unpasteurised milk sold on the informal market.

The structure of the model presented in Equations (1)–(4) is represented in Figure 4. As pointed out in [38], affluent urban consumers demand milk of “high quality,” which is imported (i.e., powder milk). The poor urban consumers buy far less powder milk (due to its price), and these are the main group demanding domestic pasteurised milk and, to some extent, milk from the informal market. The rural population consume mostly milk from the informal market.

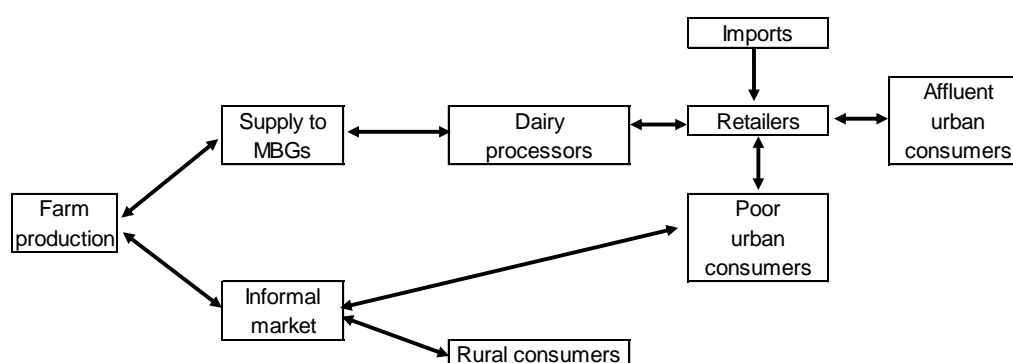


Figure 4. Overall structure of the model.

#### 4.2. Data and Model Calibration

The data used for the analysis were compiled from a number of sources. The information on production were from the livestock census carried out by the National Statistical Office of Malawi. The information was broken down by zebu (meat purpose herds) and non-zebus (dairy herds), which is the adding up of pure and mixed breeds. This is presented in Table 1.

Table 1. Malawi milk production by type of livestock.

	Zebus 1/			Non Zebus 2/			Total		
	Dairy Cows Heads	Yield Ton/Head	Production Tonnes	Dairy Cows Heads	Yield Ton/Head	Production Tonnes	Dairy Cows Heads	Yield Ton/Head	Production Tonnes
2010	68,058	0.197	13,418	27,355	1.216	33,254	95,413	0.489	46,672
2011	70,232	0.184	12,954	32,483	1.421	46,166	82,947	0.713	59,120
2012	73,313	0.203	14,874	36,954	1.182	43,694	89,261	0.656	58,568
2013	78,237	0.198	15,526	39,001	1.252	48,814	93,802	0.686	64,340
2014	82,964	0.195	16,149	42,293	1.149	48,598	99,560	0.650	64,747

Source: Based on Malawi Livestock Census. Notes: 1/ Refers to the beef herd. Number of cows estimated based on Food and Agriculture Organization of the United Nations—Statistical Division (FAOSTAT) figures (6% of the difference between the total number of zebu cattle and livestock for slaughter). 2/ Refers to the pure and mixed breed dairy cattle. Number of cows estimated as the difference between the total number of dairy cattle and livestock for slaughter.

The data on the distribution of the total milk produced was provided by the Malawi Milk Producers Association (MMPA, Lilongwe, Malawi), the Central Milk Producers Association (CREMPA, Lilongwe, Malawi), and the Shire Highland Milk Producers Association (SHMPA, Blantyre, Malawi) (South region). The relationships were calibrated using information available for year 2015. Data on the milk cost of production (US\$ 0.78 per cow/day) was provided by SHMPA.

#### 4.2.1. Production of Milk

The aggregated production of milk was calibrated using the positive mathematical programming approach [40]. The model was formulated around deciding the number of dairy cows to include in production. Milk prices constrain the amount of purchased inputs that the farmers can buy and thus affect the milk yield per cow.

The mathematical programming model is given by Equation (5) and is based on the assumption that average yields decrease with the number of cows in production (i.e., the most productive cows are milked first and, as the price increases, less productive cows are incorporated into the production plan):

$$\begin{aligned} \text{Max}_{\text{C}} \pi^{\text{F}} &= P^{\text{F}}(\alpha_0 - \alpha_1 C)C - W^{\text{F}} \cdot C \\ W^{\text{F}} \cdot C &\leq \overline{\text{M}} \end{aligned} \quad (5)$$

where  $\pi^{\text{F}}$  is the farmers' gross margin,  $C$  represents the number of cows,  $W^{\text{F}} \cdot C$  is the cost of the purchased inputs,  $P^{\text{F}}$  is the average price received by the farmer,  $W^{\text{F}}$  is the purchased inputs price,  $\overline{\text{M}}$  is the money resource that constrains the purchase of inputs, and  $\alpha_0$  and  $\alpha_1$  are parameters of the average milk yield per cow. The solution of problem Equation (5) provides the supply of milk.

#### 4.2.2. Processors Demand for Milk

Table 2 presents the processing sector information used for calibration. Note that processors pay the MBGs for the milk and these pay the farmers. The difference between the two prices covers the administrative costs of the MBGs.

**Table 2.** Processing sector information.

	Processors' Share % of Total Production	Informal Sector Share % of Total Production	Total	Prices Paid 1/	
				By Processors	To Farmers
				US \$	US \$
2010	45.3	54.7	100.0	0.483	0.442
2011	37.6	62.4	100.0	0.349	0.325
2012	40.8	59.2	100.0	0.237	0.225
2013	35.7	64.3	100.0	0.190	0.181
2014	40.7	59.3	100.0	0.231	0.214

Source: Based on Malawi Livestock Census, SHMPA, and Malawi Milk Producers Association (MMPA) data. Note: 1/ Prices transformed into US\$ using the average exchange rate.

Results from Revored-Giha et al., (2013, 2015), indicate that processors face a stable supply of milk that is responsive to prices and they set milk prices that are paid to MBGs. Therefore, the inverse supply of milk faced by the processors was calibrated according to problem (6):

$$\text{Max}_{\text{B}} \pi = P^{\text{W}} \cdot Q^{\text{R}}(\text{B}) - P^{\text{F}} \cdot \text{B} \quad (6)$$

where  $P^{\text{W}}$  is the average wholesale price for processors' products,  $Q^{\text{R}}(\text{B})$  is the quantity of an aggregated retail dairy product (measured in milk quantity) made of the delivery of  $\text{B}$  milk;  $P^{\text{F}}$  is the price of milk paid by processor to the farmer. To simplify the problem, it was assumed that  $Q^{\text{R}}(\text{B})$  can be expressed as  $Q^{\text{R}}(\text{B}) = \frac{\text{B}}{\lambda}$ , where  $\lambda$  is the conversion factor from milk to processed milk and  $\lambda \geq 1$ . The inverse supply of milk that processors face was assumed to be linear (note that this is the supply of milk from those farmers delivering to processors, which is lower than the total production of milk in the country, as part of the milk is delivered to the informal market). Replacing the supply of milk,  $P^{\text{F}} = \beta_0 + \beta_1$ , into problem (6) yields problem (7):

$$\text{Max}_{\text{B}} \pi = P^{\text{W}} \cdot Q^{\text{R}}(\text{B}) - (\beta_0 + \beta_1 \text{B}) \cdot \text{B} \quad (7)$$

Maximising processors' profits in Equation (7) with respect to  $B$ , one obtains Equation (8):

$$P^W = \lambda(\beta_0 + 2\beta_1 B) \quad (8)$$

Combining Equation (8) with the definition of  $P^F$ , one obtains the calibrated values for  $\hat{\beta}_0$  and  $\hat{\beta}_1$  in terms of observed data Equations (9) and (10):

$$\hat{\beta}_1 = \frac{\frac{P^W}{\lambda} - P^F}{B} (9 - 1) \quad (9)$$

$$\hat{\beta}_0 = P^F - \hat{\beta}_1 B (9 - 2) \quad (10)$$

#### 4.2.3. Consumers Demand for Milk

A remaining point is the calibration of cross price elasticities based on own price elasticities, income elasticities, quantities purchased, and prices.

There is no data on the demand for milk in the informal market, besides anecdotal information. This indicates that the prices on that market are similar to the price of milk paid by the MBGs, with some variation [44]. It was assumed that the informal market received all the milk that was not delivered to the processors, and that the price paid to farmers was equal to the average price paid by the MBGs to farmers in the formal market. The data used for the calibration are presented in Table 3.

**Table 3.** Available data for calibration of a partial demand system in Malawi.

Goods	Quantities kg	Domestic Prices (kw/kg)	Own-Price Elasticity	Income Elasticity	Source
Imported	29,179,104	678	−0.786	1.120	[38]
Domestic	18,148,309	475	−0.848	1.456	[38]
Informal	41,803,584	375	−0.509	0.877	[45]
Income (US\$ million)		5386			

Source: SHMPA, MMPA, [38,45].

The calibration of the elasticities was carried out using the [39], procedure. They introduced a flexible calibration technique for partial demand systems that combines developments in incomplete demand systems and a set of restrictions conditioned on the available elasticity estimates. The technique accommodates various degrees of knowledge on cross-price elasticities, satisfies curvature restrictions, and allows the recovery of an exact welfare measure for policy analysis. It calibrates the parameters based on an incomplete demand system, the LinQuad model [46], which is quadratic in prices and linear in income.

The demand system consisted of three milk products: domestic pasteurised milk, powder milk, and informal market milk. Table 4 presents the calibrated elasticities and the checks of the demand integrability conditions (i.e., that they comply with economic theory).

The supply chain model used for the simulation of the tax change comprises the production stage, processing stage, and the aggregated demand for milk products. Due to limited data, the retail and processing sectors were modelled together. The endogenous variables in the model were the different prices (e.g., price of pasteurised milk and price paid to farmers) and quantities (i.e., processed products, milk delivered to processors, milk production, number of cows, and milk yield). The model was simulated considering that the price of the domestic processed product was subject to a VAT rate of 16.5 percent (from a zero rate).

As the model is a mix of a mathematical programming model (production) and non-linear equations, it is required to be solved numerically in an iterative way. The full model was implemented in a MS Excel Workbook, solved and simulated using Visual Basic routines in combination with the MS Excel Solver.

**Table 4.** Calibrated demand elasticities.

<b>Marshallian Elasticities</b>			
	Powder milk	Domestic milk	Informal milk
Powder milk	−0.78600	0.00192	−0.00099
Domestic milk	0.00146	−0.84800	−0.00129
Informal milk	0.00088	0.00150	−0.50900
<b>Hicksian Elasticities</b>			
	Powder milk	Domestic milk	Informal milk
Powder milk	−0.77618	0.00620	0.00679
Domestic milk	0.01422	−0.84244	0.00882
Informal milk	0.00857	0.00485	−0.50291
<b>Check of the Integrability Conditions (Diagonal <math>\leq 0</math>) 1/</b>			
	Powder milk	Domestic milk	Informal milk
Powder milk	0.76313		
Domestic milk		0.81928	
Informal milk			0.48942

Note: 1/ If the integrability conditions are satisfied, then the hypothesis that the estimated elasticities reflect the theoretical conditions underlying demand systems cannot be rejected [39].

## 5. Results: Impact of the VAT on the Dairy Supply Chain

### 5.1. Impact on Processors

The introduction of VAT has led to an increase in the price of pasteurised milk at retail level and a subsequent decrease in the quantity demanded from processors. This has been reflected in the accumulation of stocks by processors. It has been estimated that an increase in the retail price of pasteurised milk to fully reflect the change in VAT (i.e., by 16.5 percent) would have led to a reduction in the quantity demanded for domestic pasteurised milk by about 14 percent.

The results from the simulation for processors are presented in Table 5. The contraction in the quantity demanded for pasteurised milk had the effect of forcing processors to change their supply schedule and absorb part of the increase in the retail price by reducing their price (ex-factory price). Thus, it is expected that the final equilibrium would reduce the quantities of pasteurised milk sold (and produced) by about 3 percent, and the processor price by about 11 percent. Therefore, the full effect of the VAT on the processors will be a reduction in their income by 14 percent.

**Table 5.** Processors' simulation results.

<b>Industry Variables</b>	<b>Tax Rate = 0%</b>	<b>Tax Rate = 16.5%</b>	<b>% Change</b>
Pasteurised milk production/consumption (kg)	18,148,308.6	17,598,987.8	−3.03
Pasteurised milk at retailer price (US\$/kg)	0.655	0.678	3.56
Pasteurised milk ex-factory (US\$/kg)	0.655	0.582	−11.11
Revenue (US\$)	11,890,271.1	10,249,551.8	−13.80
Variable cost (US\$)	8,228,067.6	6,805,691.3	−17.29
Short term profit (US\$)	3,662,203.5	3,443,860.5	−5.96

### 5.2. Impact on Milk Bulking Groups and Milk Suppliers

Table 6 presents the simulation results for the MBGs and the farmers delivering milk to MBGs. The simulation indicates that, due to the decrease in the production of processed products, the milk collection and the new equilibrium price paid to farmers will also decrease by 3 percent and about 24 percent, respectively. Moreover, the short-term profits for the farmers delivering to MBGs are expected to decrease by 27 percent. The decrease in the price paid to farmers will reduce the proportion of milk

delivered to MBGs in the total milk production from 34 percent to 33 percent. This is expected to lead to an increase in the milk deliveries to the informal market by 1.6 percent.

**Table 6.** MBGs simulation results.

Industry Variables	Tax Rate = 0%	Tax Rate = 16.5%	% Change
Milk delivered to processors by farmers (kg)	21,777,970.3	21,118,785.4	−3.03
Farmers' milk price (US\$/kg)	0.210	0.159	−24.07
Revenue (US\$)	13,330,201.7	9,814,984.1	−26.37
Variable cost (US\$)	77,725.3	77,653.0	−0.09
Short term profit (US\$)	13,252,476.4	9,737,331.1	−26.52

Farmers delivering to MBGs will be worse off due to a decrease in the price they receive and the reduction in the quantity of milk requested from them in the formal market. The MBGs income will also be worse off due to the reduction in milk collection, and the decrease in the difference between the price paid to them by processors and the price paid by them to farmers.

### 5.3. Impact on Milk Production

The results on milk production (i.e., farm level) are presented in Table 7. The estimates indicate that the total production of milk, which includes milk from zebu and non-zebu livestock is very insensitive to prices (recall that this is different from the supply of milk to MBGs, which was found to be responsive to prices; see [47]).

**Table 7.** Farmers' milk production simulation results.

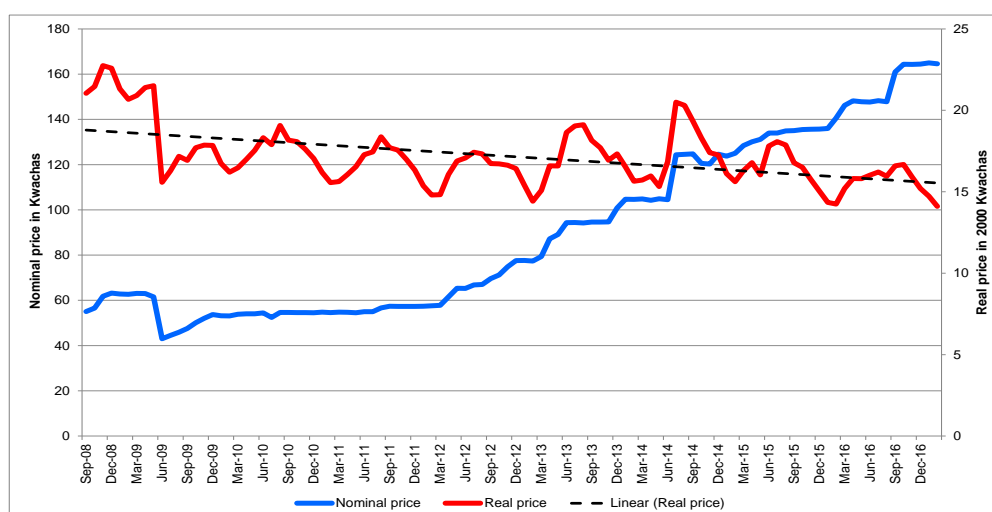
Industry Variables	Tax Rate = 0%	Tax Rate = 16.5%	% Change
Milk production	63,581,554.0	63,581,154.7	0.00
Number of cows in production	99,559.7	99,467.2	−0.09
Milk yield (litres/cow)	638.6	639.2	0.09

Due to the price insensitivity of the milk production, the total production of milk was expected to remain almost the same after the introduction of VAT. Whilst the income of farmers selling milk to the MBGs is expected to decrease due to VAT (by 27 percent as shown in Table 6), it is not clear what the impacts on those farmers selling in the informal market would be, although one should expect that more milk would be sold in that market.

Decreases in the income of farmers delivering to MBGs is a worrisome outcome because milk production is an activity that has the potential to support farmers' income [14]. Moreover, as shown in [7], inflation in Malawi erodes significantly the purchasing power of dairy producers supplying the formal market. Figure 5, which presents the prices received by farmers in nominal and in real terms, shows that the real prices have a negative trend during the period considered. This is due to the fact that nominal prices are only adjusted sporadically.

### 5.4. Impact on Consumption of Milk

Table 8 presents the simulation results for the consumption of milk. The per capita consumption of milk in Malawi in year 2012 was estimated at 5.7 kg per person using apparent consumption data [8]. Using the same calculation, our results indicate that the introduction of VAT will not significantly affect the per capita consumption of milk at the country level (in contrast to the poor urban areas whose consumption is expected to decrease by 3 percent), which will only suffer a minor contraction of 0.2 percent due to the reduction in the imports of milk. Note that the reduction in the imports of milk is expected to be negligible because most imports are of powder milk, which in 2015 (latest available information) represented about 98 percent of the milk imports and were already taxed at the standard VAT rate.



**Figure 5.** Nominal and real weighted average price of milk paid to farmers. Source: Based on SHMPA and National Statistical Office of Malawi (NSO) data.

**Table 8.** Farmers' simulation results.

Industry Variables	Tax Rate = 0%	Tax Rate = 16.5%	% Change
Processed product quantity demanded (kg)	18,148,308.6	17,598,987.8	−3.03
Expenditure (US\$)	11,906,694.2	11,957,220.6	0.42
Imported product quantity demanded (kg)	29,179,104.0	29,086,382.0	−0.32
Expenditure on milk imports (US\$)	27,325,183.0	27,348,315.8	0.08
Per capita consumption (kg)	5.4	5.4	−0.10

As mentioned above, the domestic demand for pasteurised milk is expected to decrease by 3 percent and the final retail price for domestic milk is expected to increase by about 3 percent, and therefore, consumers' expenditure for pasteurised milk would rise only by 0.4 percent.

The quantity of milk traded in the informal market is expected to increase by about 1.6 percent and that is mainly because of the reduction in milk prices paid to farmers, which may lead to their selling a slightly higher proportion of their milk on the informal market.

### 5.5. Impact on Government

The results indicate that the introduction of the VAT is expected to increase the Government of Malawi tax revenues to US\$ 1.7 million per year (from zero). Adding to this, there is a minimal increase (US\$ 0.1 million per year) in tax revenues from imported milk, most of which already taxed at the standard VAT rate pre 2016.

## 6. Discussion

This section discusses the implications of the VAT introduction in terms of its incidence and effects on the agri-food value chains.

Table 9 presents the results of the VAT incidence analysis. These indicate that consumers are expected to bear about 24.3 percent of the tax collection, whilst the industry bears the remaining 75.7 percent. These results contrast with evidence that indicates that the VAT is mostly borne by consumers (e.g., [34]). However, this is not surprising as the main consumers of domestic milk are poor urban consumers who are very sensitive to changes in prices. An increase in the price of a good of the magnitude of the VAT rate analysed here reduces substantively its consumption, subsequently forcing the price increase to be shared among actors upstream the supply chain. This is a negative outcome for both consumers and the supply chain as the former reduce their consumption of a staple food



product and the latter faces a reduction in production with consequences in terms of its economic and social sustainability.

**Table 9.** Incidence of the VAT, simulation results.

Industry Variables	Tax Rate = 0%	Tax Rate = 16.5%	% Change
Tax incidence	-	1,693,511.9	100.00
Consumers	-	410,923.3	24.26
Industry	-	1,282,588.6	75.74
Inefficiency 1/		26,430.0	0.22

1/ Expressed as percentage of the pre-VAT domestic product sales.

Table 9 also presents a calculation of the inefficiency created by the introduction of the VAT (i.e., the economic benefit foregone due to the tax and thus not reaching either consumers, producers, or the government). This was estimated to be 0.2 percent of the total milk sales before VAT.

As pointed out by [1], uncertainty is present in smallholder value chains and it relates to a number of interrelated areas such as the insecure nature of agricultural production; market dynamics, with shifts in supply and demand patterns linked to factors such as demographic change; and technological innovation. One of the most significant is the economic environment in which these value chains operate.

The introduction of the VAT provides not only an opportunity to better understand the functioning of the dairy supply chain in Malawi and to observe its vulnerability to changes in the policy framework, but also to extract lessons for similar value chains. Changes in taxation and other policies are a common occurrence, particularly in developing countries where macroeconomic pressures are an important source of uncertainty for economic agents.

An important debate in development economics is how to assist smallholder farmers in moving forward and to facilitate their connection to the market in order to reach sustainable growth (e.g., [11]). Value chains are a mechanism to achieve this. This type of development approach has been named as a “demand-side” approach where private agents (entrepreneurs, producer organisations) create incentives for smallholder farmers to modernise through contracting and vertical coordination in value chains [48].

According to [48] “a demand-side approach consists in creating incentives for smallholder farmers to modernise through their participation in vertically coordinated value chains that provide links to markets for products with a profitable effective demand, while at the same time potentially offering solutions to market and institutional failures” (p. 9). The advantage of a demand-side approach, in contrast to a supply side one (e.g., aiming to remove barriers in production), is that it seeks broad complementarities to achieve modernisation, specific to the agent in question.

This study clearly points out that changes in taxation policy can be damaging to smallholder supply chains, common in developing countries, and can have significant economic and social sustainability effects as these chains are embedded into rural communities. The analysis raises two related questions, whether these chains can be taxed and when. The answer to both questions is not straightforward, as a solution to how and for how long to support an “infant” industry in developing countries is still under debate [49]. This needs to be evaluated by carefully taking into account the reaction of a specific chain. As pointed out by [2], in many cases tax decisions are taken as a leap in the dark by authorities, which creates additional uncertainties to the value chain.

## 7. Conclusions

The dairy sector in Malawi can be considered an example of an inclusive supply chain where smallholder farmers are integrated into the business and the final product is sold domestically. This paper investigated the effects that the short-lived VAT would have had on the different stages of the domestic dairy supply chain, as well as the incidence of the tax. Some conclusions emerged:

The government tax revenues would be borne by both consumers (24.3 percent of VAT revenues) and the domestic dairy industry (75.7 percent of VAT revenues). This is mainly due to the fact that consumers' demand for pasteurised milk is very sensitive to changes in prices and cannot absorb the full increase in price due to VAT without contracting significantly. This forced the industry to reduce prices along the supply chain up to retail and shrink production to avoid an unsustainable accumulation of stocks.

The fact that most of the VAT revenues were paid by the industry means that the measure affected not only processors, but also the farmers. This is particularly important because milk is an important source of income for farmers.

The consumption results indicate that the introduction of VAT will not significantly affect the per capita consumption of milk (for all the population), which would only suffer a minor contraction of 0.2 percent due to the reduction in the demand for imported milk. The domestic demand for pasteurised milk (most of which linked to poor urban households) would be expected to decrease by 3 percent. The quantity of milk farmers sold on the informal market would be expected to increase by about 1.6 percent due to the reduction in milk prices paid to farmers on the formal market.

The tax measure hit a sector already greatly affected by infrastructure issues such as electric power cuts, factory breakdowns, and impassable access roads, which, despite the aforementioned challenges, has been a good source of investment in Malawi. Moreover, it has been supported by donors which recognised its potential to increase the income of poor farmers, particularly those in the South of Malawi lacking economic choices.

The implications of the results for the dairy industry provide lessons for international development. The international development community are increasingly interested in stimulating agricultural transformation through improved productivity, increased market access for smallholder farmers and investment in agribusiness [50]. Moreover, they seek to increase economic opportunities for smallholders by demonstrating the commercial viability of businesses with significant smallholder supply chains and attracting more investment into the sector.

Under the guiding idea that economic growth is most effective in reducing poverty when it occurs in sectors that are important to the poor as a source of income or employment [51], there has been interest in encouraging private sector investment in inclusive innovative business models, particularly in the manufacturing and agriculture sectors.

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